

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency
Engines and Turbines

12/2002



MEASUREMENTS FOR IMPROVED UNDERSTANDING OF COMBUSTION DYNAMICS IN LEAN PREMIXED GAS TURBINE COMBUSTOR FLAMES

PRIMARY PARTNER

Purdue University

TOTAL ESTIMATED COST

\$ 167,390

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems Research (AGTSR) program, Purdue University is using advanced sensors to investigate the role of unsteady fluid mechanical phenomena in combustion instabilities. Task 1 of the project designs and builds two premixers with configuration variability representative of a range in designs significant to gas turbines. Figure 1 shows a radial swirl premixer fabricated for the project. Task 2 selects promising swirler combinations for the two premixer designs by constructing and evaluating operating range maps, pollution index maps, and pressure oscillation level maps for the premixer/swirler configurations. Six promising premixer/swirler configurations are anticipated from these evaluations. Task 3 obtains simultaneous Particle Imaging Velocimetry (PIV) measurements, CH chemiluminescence, and system pressure oscillation measurements for the six premixer/swirler combinations at three operating conditions near lean blowout just prior to the steep rise in NO_x emission indices. The effects of premixer/swirler configuration on performance and instabilities will be characterized.

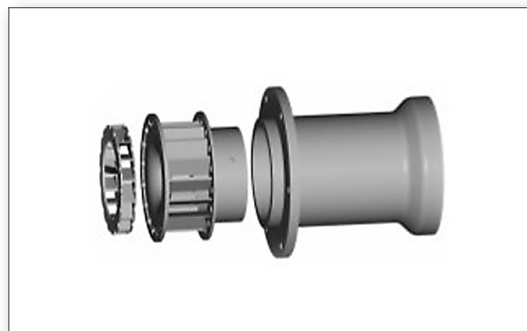


Figure 1. Assembly of a radial swirl premixer
fabricated by a rapid prototyping system



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Duration

24 months

Goals

Combustion instabilities in lean premixed low emission combustors have caused turbine shutdowns in the field due to noise and damage resulting from pressure oscillations. This project obtains data on effects of premixer design on combustor flow fields and pressure oscillations.

Benefits

Observed variations of the flow field structure and pressure oscillations for the tested range of premixer/swirler designs will guide turbine engineers by identifying design features that extend lean blowout limits and alleviate combustion instabilities.